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Technical Notes
A Publication of RCA| Princeton,NJ

~~807/341~~

Recipient's Date Stamp:

RCA

TN No.: 807
Mailed: December 11, 1968

CHEMICAL SEPARATION OF SEMICONDUCTOR DEVICES FORMED IN A SUBSTRATE

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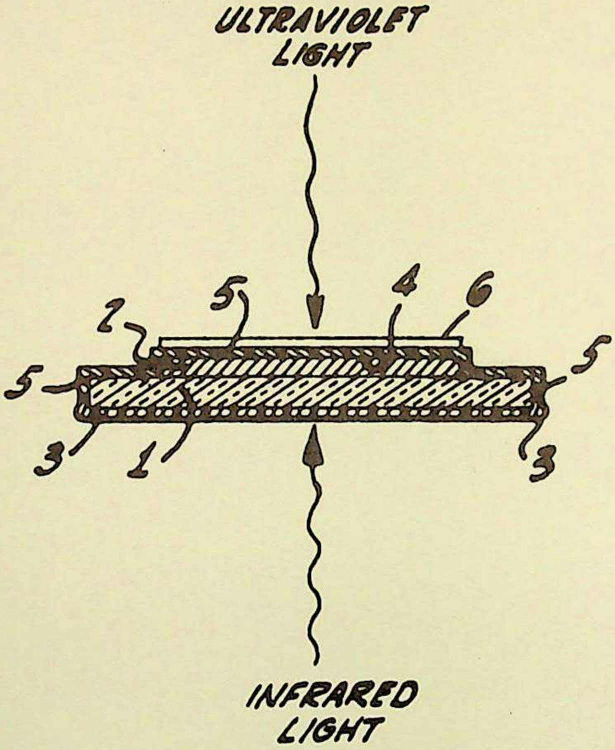

In the manufacture of beam lead discrete devices or integrated circuits, individual active or passive elements are formed by diffusion of suitable impurities into a silicon substrate. After deposition of the metallic beam lead interconnections, the various active or passive elements are electrically isolated from each other by dissolving the inactive substrate material surrounding the elements.

In the conventional beam lead process as described, e.g., in an article by Stanley S. Hause and Robert A. Whitner and entitled "Manufacturing Beam-Lead, Sealed-Junction Monolithic Integrated Circuits," published in the Western Electric Engineer, December 1967, the processed silicon wafer (after metallization) is subjected to the separation process in the following fashion.

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First, the wafer is mounted with wax, onto a flat sapphire disk, so that the beam lead metallized wafer surface is in contact with the disk. The back surface of the wafer is then lapped to a reduced thickness, on the order of 2 mils. The lapped surface is coated with a photoresist capable of serving as a silicon etch mask. A suitable photomask is aligned with the photoresist coated surface, and the exposed portions of the photoresist surface are illuminated by ultraviolet light to define the desired etch pattern. After development to remove selected parts of the photoresist layer in accordance with the pattern, the portions of the silicon wafer exposed through the developed photoresist etch mask are dissolved in a suitable etchant.

The photomask employed is aligned with the photoresist coated surface by observing the shadows of the metallization pattern as viewed by infrared light which is shined through the sapphire disk and the silicon wafer.

Sapphire is employed as the disk material because it transmits infrared light and is capable of withstanding chemical attack by the etching solution used to dissolve the inactive portions of the silicon wafer. The sapphire disks, however, are quite expensive and a large number of disks must be employed where volume production of beam lead devices is contemplated.

By the arrangement shown in the drawing, a quartz or Pyrex disk 1 may be substituted for the sapphire disk previously employed. A metallized beam lead silicon wafer 2 to be processed is mounted with wax onto the quartz or Pyrex disk 1 so that the metallized surface of the wafer 2 is in contact with the disk 1.

Since quartz and Pyrex transmit infrared light, but cannot withstand chemical attack by the (nitric-hydrofluroic acid) etching solution, the disk 1 is protected from the etchant by coating the disk 1 and the wafer 2 mounted thereon with a suitable photoresist such as Kodak KPR. This photoresist is then polymerized by exposure to diffuse ultraviolet light shined onto the back surface of the disk 1, thus forming a hardened etch resistant layer 3.

During this step, the silicon wafer acts as its own mask, so that the back surface of the wafer (i.e., the surface not in contact with the disk 1) is not irradiated. The photoresist covering the back surface of the wafer is removed by immersion in a suitable developer.

The back surface 4 of the silicon wafer 2 is then etched in the conventional fashion by applying another photoresist layer 5 to the back surface of the wafer, placing a suitable photomask 6 on the photoresist layer 5, and exposing the photoresist layer 5 to ultraviolet light through the photomask 6. The photomask 6 is aligned with the silicon wafer 2 by observing the shadows of the beam leads in infrared light shined through the resist layer 3, Pyrex disk 1, silicon wafer 2, and photoresist layer 5. The photoresist layer 5 is then developed and employed as an etch mask for removal of the inactive portions of the silicon wafer 2.

In addition to reducing cost, the quartz or Pyrex disk 1 is more practical than the sapphire disk in that it exhibits improved infrared transmission and greater resistance to cracking during heat treatment and handling operations.